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AN INTERIM INTERSTELLAR RADIATION FIELD

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SOMMAIRE. — *Les observations d'étoiles faites à bord de fusées dans l'ultraviolet sont en désaccord avec les calculs de modèles d'atmosphères. On indique la forme générale du champ de radiation interstellaire telle qu'elle apparaîtra quand on disposera de plus d'observations.*

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ABSTRACT. — *Stellar observations in the ultraviolet made from rockets are in serious disagreement with the predictions of model atmospheres. The general form that the interstellar radiation field will take when more observations are available is indicated.*

Author

Внутреннее поле межзвездного излучения.

Резюме. — Наблюдения звезд в ультрафиолетовом участке, сделанные с ракет, находятся в разногласии с вычислениями моделей атмосфер. Указывается общая форма поля межзвездного излучения, таковая, какой она окажется при бо́льшем числе наблюдений.

There are many interesting problems in which a knowledge of the interstellar radiation field is essential. DUNHAM (1939) made the classical calculation of the interstellar radiation field. To make this calculation he assumed that each star radiated as a black body. Recently LAMBRECHT and ZIMMERMAN (1955) recalculated the field using model atmospheres instead of black bodies for the stars. The total energy of their calculation agreed very well but the spectral energy distribution was considerably changed in the ultraviolet.

The observational results of stellar spectrophotometry (STECHER and MILLIGAN, 1962) and stellar photometry (KUPPERIAN, BOGGESS and MILLIGAN, 1958) (BOGGESS, 1961) obtained with rockets in the ultraviolet are in serious disagreement with the prediction of model atmospheres. While sufficient data is not available at this time to construct a definitive radiation field it is felt desirable to indicate the form such a field would take.

The stellar spectrophotometry of STECHER and MILLIGAN (1962) indicates that for stars from α Canis Majoris A_1V to ζ Puppus, 0_5f and γ Velorium WC7, a deviation from the model atmospheres starts at λ 2600. At λ 2000 they have a factor of ten less flux than the models have. This decrease increases to a factor of twenty at λ 1600 which is as far as the spectral observations go. At λ 1300 photometry by KUPPERIAN, BOGGESS and MILLIGAN (1958) gives an upper limit for α Virginis, B_1V, that is a factor of thirty less than the appropriate model. Also at λ 1300 BOGGESS (1961) reports that ε Persei B_1V is down a factor of 30. While no data is available below λ 1200 it appears unlikely that there would be an increase in the flux and the blanketing of the hydrogen Lyman lines would probably reduce the flux even more (GAUSTAD and SPITZER, 1961).

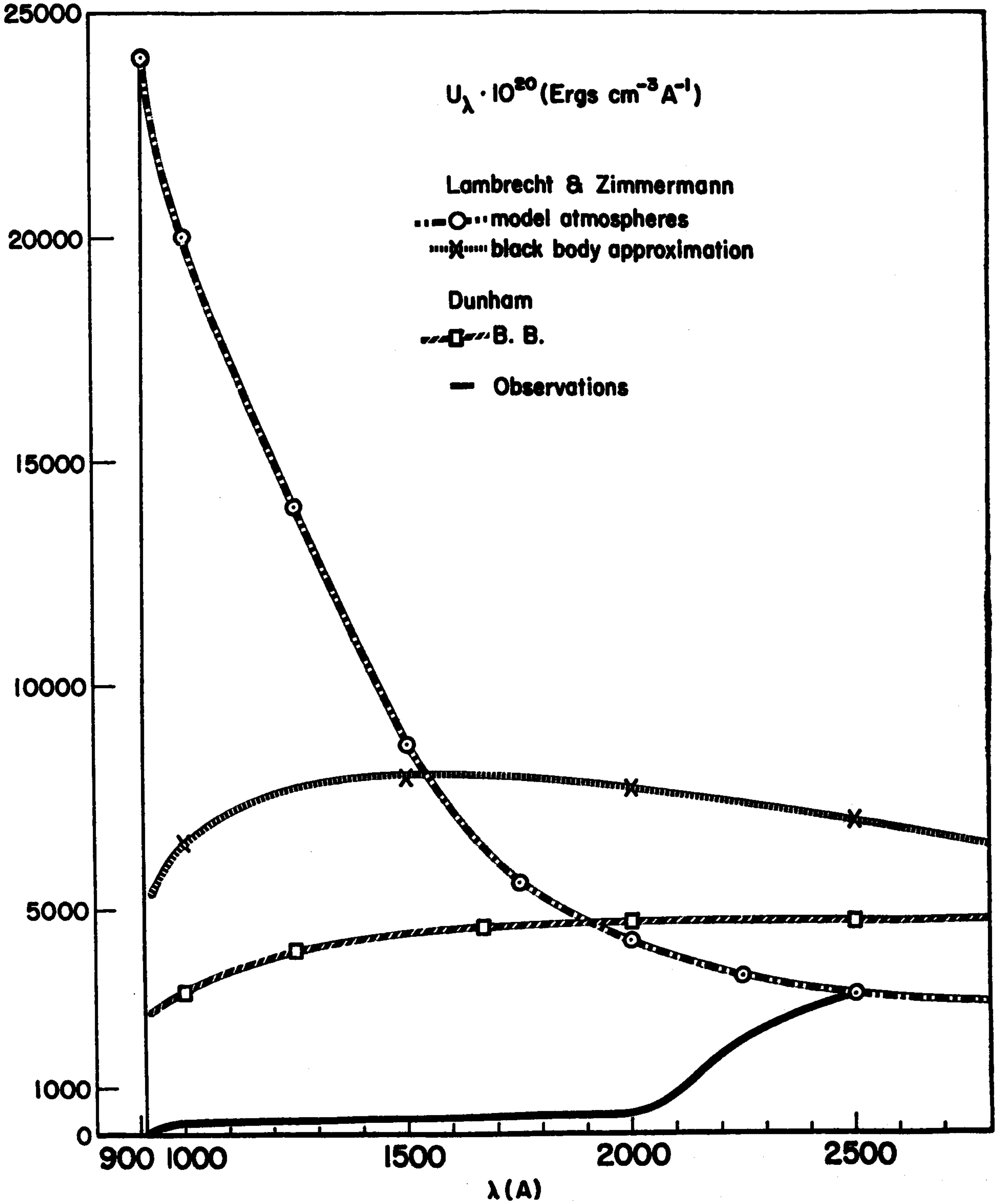
TABLE I

INTERSTELLAR RADIATION FIELD WITH ABSORPTION
$u_\lambda . 10^{20}$ erg cm^{-3} Å^{-1}

λ	912	1000	1250	1500	1750	2000	2250	2500
u_λ	100	250	350	370	370	430	2100	3100

These observational results have been used to modify the total interstellar radiation field of LAMBRECHT and ZIMMERMAN (1955). The resulting field appears in Table 1. Absorption was included in their field and is therefore, in Table I. The total energy density in the λ 0 — λ8000 region is reduced from 3.3×10^{-13} erg cm^{-3} to 2.0×10^{-13} erg cm^{-3}. The energy density

INTERSTELLAR RADIATION FIELDS, HI REGION



below λ 2250 is reduced by a factor of 18 from 1.3×10^{-13} erg cm^{-3} to 0.074×10^{-13} erg cm^{-3} In figure 1 the various radiation fields which have been used in the determination of interstellar ionic concentration in recent years are compared with the one derived from observation.

In a HI region the reduced energy density in the ultraviolet will lessen the ionization of those elements whose ionization cross-sections is in the five to thirteen electron volt range. This has a considerable effect upon the temperature calculated from ionization heating and the abundances derived for those elements.

The chemical composition of the interstellar gas has been calculated by DUNHAM (1939), STRÖMGREN (1948), SEATON (1951), WEIGERT (1955) and others. Comment may be made on the calcium-sodium abundance anomaly which has been discussed by the above writers. While there will be less ionization of sodium there will be considerably less ionization of Ca II with our suggested radiation field. Consequently, the sodium-calcium abundance remains about the same as that calculated by SEATON (1951) with Dunham's field and the anomaly is not removed. The possibilities that remain are (1) it is a true anomaly (2) the stars have bright broad Lyman lines (3) the lines are formed in HII regions rather than HI or (4) the calcium is tied up in grains. In order to make further progress in this area the detailed field for a single cloud must be calculated and the ionic concentration compared with unambiguous observations.

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